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(54) Title: PROCESS AND PRODUCT FOR RELEASING BOUND WATER

(57) Abstract

A process for gradually providing water to an object utilizing a gel material having a releasably bound water. The gel material possesses a pre-determined morphological stability which may be linked to a pre-determined rate of release of the water from the gel. The gel is placed in the chamber of a container which has an opening which communicates with the chamber. The container is placed adjacent the object to permit the gel material to contact the object by way of the opening to the chamber of the container.

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+ DESIGNATIONS OF "SU"

It is under examination in which parts of the former Soviet Union the designation of the Soviet Union has effect.

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PROCESS AND PRODUCT FOR RELEASING BOUND WATER

BACKGROUND OF THE INVENTION

The present invention r lates to a novel process and compositions which gradually release water to an object such as a biological entity.

Providing water to sustain plants and animals, to heal burned tissue, to humidify rooms, maintain moisture levels on inanimate structures, and the like, is an age-old problem. For example drought conditions exist during relatively short time periods, thirty days or less, as well as periods measured by years. Lack of water affects the growth of all plants, such as those found in a household to saplings employed in reforestation projects. Of course, provision of water through an irrigation system, although adequate, is often costly and labor intensive.

Drip irrigation systems were a great advance for gradual providing of water in many parts of the world. Such systems must nevertheless be connected to elaborate irrigation conduits and controls, which severely limit usage.

It is known that water may be bound in certain chemical compositions having rigid and semi-rigid formulations e.g. hygroscopic salts, and certain gelatinous formations. Reference is made to United States Patent 4,865,640 which discloses a gel-like material capable of binding water for gradual release. In addition, well known household products such as margarine and mayonnaise are capable of binding water and are morphologically stable during hermetic storage periods of a year or more. On the other hand, the commonly available French salad dressing is a water binding material which is morphologically stable under hermetic conditions for only several minutes.

In addition, release of the bound water from certain compositions is believed to be solely keyed to microbiological activity which is unacceptable where the bound water must be in a sterile environment, such as treating a burned skin area.

A process and composition for gradually releasing

bound water to inanimate or biological objects at a controlled rate of release would be a notable advance in the chemical field of invention.

SUMMARY OF THE INVENTION

In accordance with the present invention a novel and useful process and composition for the gradual or timed release of bound water is herein provided.

The process of the present invention utilizes a step of providing a gel material having water releasably bound in the gel material. The percentage of water in the gel material varies between 50 percent water to 99.9 percent water by weight. The gel material may possess a pre-determined morphological stability which is directly linked to a pre-determined rate of release of the water from the gel.

The water binding gel material may consist of 0.1 to 0.5 percent by weight of a metallic salt hydrate, 0.9-3.0 percent by weight of a water binder material associated with a metal, and the remainder being water. The metal of the metallic salt hydrate component may possess a higher value on the electromotive scale than the metal associated with the water binder material. By adjusting the concentration of the water binder material morphological stability and water release rates may be pre-determined. For example, the metallic salt hydrate may be aluminum sulfate hydrate or magnesium sulfate hydrate. On the other hand, the water binder material metal may be sodium or potassium carboxy methyl cellulose. Also, the gel material may comprise water in combination with a plant mucilage, a hydrophilic polysaccharide, a natural gum such as guar gum, starch, a plant mucilage derivative such as the ground endosperm of Cyanosis tetragonoloba and the like.

Although certain of the water binders disclosed in this invention are activated by microorganic life forms, the morphological stability also may be chemically predetermined to act independently of such microbiological triggers.

The gel employed in the present process may rel ase water by sublimation and may be placed in a chamber of a container having an opening that is sealable. In many

cases, the container may be constructed of transparent material to observe the morphological changes occurring with regard to the gel during the timed release of water to an object such as a plant or animal. In this regard, the container is positioned adjacent the object to permit the gel material to contact the object via the opening to the chamber of the container. In certain cases, the object, such as a cut flower, may be placed within the chamber of the container followed by sealing of the container opening around the cut flower. In this case, water leaves the gel by sublimation.

Again, the contacting of the gel binding the releasable water with an object may be dependent or independent of microbiological activation. In certain cases, the gel may be placed adjacent a capillary surface which may integrally formed with the water receiving object. Further, the water in the gel may be released by the application of pressure. It should be noted that the container having the chamber may be a flexible container as well as a rigid container.

The process of the present invention also includes provision of transforming water to a gas to raise the relative humidity of an enclosure such as a room. In releasing water by sublimation the gel, hereinbefore described, would be placed in the enclosure such that the gas filling the enclosure contacts the gel material. An open container may be used in this regard to somewhat confine the gel material within the enclosure.

It may be apparent that a novel and useful process for gradually providing water to an object has been described.

It is therefore an object of the present invention to provide a process for gradually providing water to an object in a form which may possess a variety of morphological stabilities and a variety of release rates of the bound water commensurate therewith.

It is another object to provide a process for gradually providing water to an object which includes a

visual feedback mechanism to meter such water release.

Yet another object of the present invention is to provide a process for gradually providing water to an object which may react to microbiological or microorganism activation or simply release water according to a morphological change.

Yet another object of the present invention is to provide a process for gradually providing water to an object which employs a gel material of predetermined morphological stability and, thus, has a predetermined rate of release of the bound water.

Another object of the present invention is to provide a process for gradually providing water to an object which has wide scale applications to animate and inanimate objects where the gradual release of water is required.

A further object of the present invention is to provide a process for gradually providing water to an object which employs a gel material capable of releasing water by a variety of mechanisms.

The invention possesses other objects and advantages which will become apparent as the specification continues.

The invention may be illustrated by the following examples, but is not deemed to be limited by the same.

EXAMPLE I

97.2 parts potable and sterile water was mixed at high speeds with 0.1 parts aluminum sulfate hydrate, and 1.7 parts guar gum sold under the trademark Dycol 4500F and distributed by National Starch and Chemical Corp. The final component was 1.0 parts high viscosity sodium carboxy methyl cellulose. The thickened binder was poured into a hermetic container for sealing and storage. It was noted that the viscosity of the binder material was quite high while being poured into such container. After a few minutes, the product within the container became a gel-like, non-fluid material appearing white and dense. An aliquot was placed in a two fluid ounce plastic cup and

inverted on top of the soil of a six inch pot in which a miniature palm was growing. The palm was nurtured with gradually rel ased water over an 11 day period. At this time, the cup was observed to be empty of gel material. Simultaneously, with the nurturing of the palm, the remaining gel material was kept in hermetic storage. The gel was observed to gradually separate and release water believed to be due to morphological change.

EXAMPLE II

98 parts sterile potable water (± 0.3 parts) was mixed with approximately 2 parts of a combined polysaccharide and protein material known as guar gum, under vigorous agitation and at room temperature. A barely pourable bound water mass was produced which became non-fluid in a very short period of time. This bound water mass was stored in a hermetic container for several days and then placed in a two fluid ounce transparent plastic cup having an open mouth. The plastic cup was inverted such that the open mouth of the cup rested on the soil of a small ornamental house plant holder in which a dieffenbachia was growing. In a few days it was observed that the bound water mass within the transparent plastic cup had visibly shrunk. The dieffenbachia was observed for a week with no additional water and in a furnace heated dinning room. At that point in time, there was no evidence of a lack of water nurture.

EXAMPLE III

A seven ounce plastic cup was filled with a moisturizing substrate found in Claim 1 of United States Patent 4,865,640. The open cup was stored in a room at approximately 20°C. At hourly intervals, the weight loss due to sublimation of the non-liquid bound water within the moisturizing substrate was measured. During 5 hours, there was no sign of visible liquid water present within the open plastic cup. The volume of the moisturizing substrate was visibly reduced by the sublimation process. It was calculated that the bound water sublimed at a rate of 0.25 (± o.05) grams per hour for each of the five hours of the

test. It was further calculated that the bound water at the start of the test was 193.5 grams which reduced to 192.2 grams after five hours. The surface of the moisturizing substrate undergoing sublimation was a 2 5/8 inch diameter circular area. Using a standard table for saturated steam at 20°C it was calculated that 1 cubic foot of air at 100% of relative humidity contains 0.49032 grams of water vapor. It was calculated that one cubic foot of air in a room having 50 to 70% relative humidity would be equilibrated to 100% relative humidity in one hour. It was further estimated that seven ounces of the moisturizing substrate could serve as a room humidifier for about one month. It is theorized that fragrance materials could be added to the moisturizing substrate.

EXAMPLE IV

The moisturizing substrate of example III was placed in a seven ounce cup, which was itself placed in a wide-mouth screw cap glass jar without a hermetic closure. Six fresh pink chrysanthemum blooms were cut from an actively growing plant of the same type. Three chrysanthemum blooms were placed dry in a small vase as a control. Three chrysanthemums blooms were placed in the wide-mouth glass jar with the open cup of substrate containing bound water. The screw cap was then placed on the wide-mouth glass jar and hermetically sealed with rubber tape. Within one 24 hour period, the wide-mouth screw cap glass jar showed visible indication, in the way of condensation, of a 100% relative humidity condition within the same. There was no indication of liquid water within the jar at the bottom portion. It is believed water orginating with the gel was released by sublimation. The following results were observed:

Elapsed Time	Condition of Chrysanthemum Blooms Within the Jar	Condition of Controlled Blooms
1st day	Fresh	Definite withering evident

2nd day	Flowers & Leaves not wilted	Wilted leaves & Flowers
3rd day	Flowers & Leaves not wilted	Desiccated leaves & Flowers
4th day	Flowers & Leaves not wilted	Desiccated leaves & Flowers
51/2 day	Flowers & Leaves not wilted	Desiccated leaves & Flowers

At the end of the 5 day test period the Chrysanthemums and the 7 ounce cup were removed from the opened-mouth jar. The Chrysanthemum blooms were then placed in a small vase with the ends under water. Two of the Chrysanthemum blooms which had not touched the walls of the open-mouth jar were in perfect condition. On the other hand, a flower which had been in contact with the wall of the open-mouth jar was slightly wilted but still decorative. After two days in the small vase, a total of 7 days from cutting, the Chrysanthemum blooms appeared to be good condition and the test was discontinued.

EXAMPLE V

Two pink Camellia blooms of identical size and appearance were cut from a living bush. One bloom was placed in a small vase having no water as a control. The other bloom was placed in a plastic Zip Lock envelope with 2.5 ounces of moisturizing substrate described in Example III. The bloom and the moisturizing substrate were further hermetically sealed by rubber tape. The following daily observations were recorded over a 5 day period:

Elapsed Time	Test Camellia Bloom	Controlled Bloom
1st day	Excellent Condition	Wilting Flower Petals
2nd day	Excellent Condition	Flower drooping & discolored

3rd day	Excellent Condition	Flower badly wilted, leaves darker
4th day	Excellent Condition	Flower badly wilted, leaves darker
5th day	Excellent Condition	Flower dead

EXAMPLE VI

The moisturizing substrate of Example III was prepared and exposed to an applied pressure in the gear box of a marine hoist. Liquid water was observed to be released upon the application of such pressure.

While in the foregoing, embodiments and examples of the present invention have been set forth in considerable detail for the purpose of making a complete disclosure of the invention, it may be apparent to those of skill in the art that numerous changes may be made in such detail without departing from the spirit and principles of the invention.

WHAT IS CLAIMED IS

1. A process for gradually providing water to an object comprising the steps of:

a. providing a gel material having water releasably found therein ranging from 50 percent by weight to 99.9 percent by weight, said gel material possessing a predetermined morphological stability and possessing a predetermined rate of release of the water dependent on the concentration of a water binder material associated with a metal ranging from 0.9-3.0 percent by weight.

b. placing said gel material in the chamber of a container, said container having an opening to said chamber holding said gel material; and

c. positioning said container adjacent the object to permit the gel material to contact the object via said opening to said chamber of said container.

2. The process of claim 1 in which the step of placing the gel material in a container includes a container of translucent construction.

3. The process of claim 1 in which said step of positioning said container adjacent the object includes the step of placing said gel in contact with a microorganism.

4. The process of claim 1 in which said step of positioning said container adjacent the object includes the step of placing said gel in said container on a capillary surface adjacent the object.

5. The process of claim 4 in which said capillary surface is integral with the object.

6. The process of claim 1 in which said step of placing said gel material in said chamber of a container includes placing said gel material in a flexible container.

7. The process of claim 1 in which said step of positioning said container adjacent the object to permit the gel material to contact the object includes the step of placing at least a portion of the object within the container via said opening to said chamber of said container.

8. The process of claim 1 in which said gel material having water releasably bound therein ranging from 50 percent by weight to 99.9 percent by weight, further consists of

a. 0.1-0.5 percent by weight of a metallic salt hydrate; and

b. 0.9-3.0 percent by weight of a water binder material associated with a metal,

said metal of said metallic salt hydrate possessing a higher value on the electromotive scale than said metal associated with said water binder material.

9. The process of claim 8 in which said metallic salt hydrate is selected from the group consisting of aluminum sulfate hydrate and magnesium sulfate hydrate.

10. The process of claim 8 in which said water binder material associated with a metal is selected from the group consisting of:

sodium carboxy methyl cellulose and potassium carboxy methyl cellulose.

11. The process of claim 8 in which sid gel material having water releasably found therein ranging from 50 percent by weight to 99.9 percent by weight, further consists of guar gum ranging from 0.1 percent to (5.0) percent by weight.

12. A process for gradually providing water to an object,

comprising the steps of:

a. providing a gel material having water releasably bound therein ranging from 50 percent by weight to 99.9 percent by weight, said gel material possessing a predetermined morphological stability and possessing to a predetermined rate of release of the water dependent on the concentration of a water binder material associated with a metal ranging from 0.9-3.0 percent by weight.

b. applying said gel material to the object.

13. A process for gradually providing water to gas in an enclosur comprising the steps of

a. providing a gel material having water capable

of sublimable release bound therein ranging from 50 percent by weight, said gel materials possessing a predetermined morphological stability linked to a predetermined rate of release of the water dependent on the concentration of a water binder material associated with a metal ranging from 0.9-3.0 percent by weight;

b. placing said gel material in the enclosure for contact with the gas in the enclosure.

14. The process of claim 13 in which said step of placing said gel material in the enclosure includes the step of placing said gel material in an open container.

15. The process of claim 1 which additionally comprises the step of applying pressure to said gel in said chamber of said container after said step of placing said gel material in said chamber of said container.

INTERNATIONAL SEARCH REPORT

International Application No. PCT/US91/04531

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC (5): C05D 5/00

U.S. CL: 71/1

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
U.S.	71/1, 23, 26, 903

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
X	US, A, 4,865,640 (AVERA) 12 SEPTEMBER 1989. See entire document.	1-15

* Special categories of cited documents: [10]

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
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